American POTATO JOURNAL

Volume 27 *May, 1950* *Number 5*

CONTENTS

Potato Aphid Control Studies, 1946-1949, at Woodstock, N. B., Canada—*J. B. Adams and R. A. Kelley* 175

The Effectiveness of Certain Antidotes in Counteracting the Off-Flavor in Potatoes Grown on Soil Treated with Benzene Hexachloride—*Margaret H. Harvey, Mary L. Greenwood and Neely Turner* 182

Factors Contributing to the Utility as Food of Five Grades of Michigan Potatoes—*Pauline Paul, Betty Ives Cole and Katherine G. Knight* 189

Potato Production—*E.V. Hardenburg* 199

Sectional Notes 200

Official Organ of
THE POTATO ASSOCIATION OF AMERICA
NEW BRUNSWICK, NEW JERSEY

POTATO FUNGICIDE 658

Effectively controls early and late blight

Leading agricultural experiment stations and growers report that CRAG Potato Fungicide 658 gives outstanding control of both these plant diseases, even where epidemic infestations occur. For you—this means healthier fields that give better yields and greater profits.

Whether this fungicide is applied to the foliage as a spray or in a dust formulation, it resists weathering. This means long "full-action" defense against blights. You'll save time and labor costs with this effective fungicide.

CRAG Fungicide 658 is easy to use in the field. You just add it to the spray tank with the agitator running. If you use dusts, formulations including Potato Fungicide 658 are available from your supplier. This fungicide is compatible with DDT, parathion, and calcium arsenate.

CRAG Fungicide 658 won't lose its effectiveness in storage. There's no loss—you *profit* when you buy CRAG Potato Fungicide 658. See your dealer today, or write to us.

Carbide and Carbon Chemicals Division
Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, New York
In Canada:
Carbide and Carbon Chemicals, Limited, Toronto
"Crag" is a registered trade-mark of Union Carbide and Carbon Corporation

American Potato Journal

PUBLISHED BY

THE POTATO ASSOCIATION OF AMERICA

NEW BRUNSWICK, N. J.

OFFICERS AND EXECUTIVE COMMITTEE OF THE POTATO ASSOCIATION OF AMERICA

H. A. Reiley, *President*.....Michigan Potato Growers' Exchange, Cadillac, Mich.
Reiner Bonde, *Vice-President*.....University of Maine, Orono, Maine
Ora Smith, *Secretary*.....Cornell University, Ithaca, N. Y.
John C. Campbell, *Treasurer*.....Rutgers University, New Brunswick, N. J.
Wm. H. Martin, *Editor*.....Rutgers University, New Brunswick, N. J.
O. D. Burke, *Past President*.....Pennsylvania State College, State College, Pa.
R. D. Pelkey, *Director*.....University of Idaho, Boise, Idaho
J. W. Scannell, *Director*.....Department of Agriculture, Ottawa, Canada
A. G. Tolaas, *Director*.....Department of Agriculture, St. Paul 1, Minn.

$2.00 per year, United States and Canada, $2.50 per year elsewhere.

Entered as second class matter at New Brunswick, N. J., March 14, 1942, under Act of March 3, 1879.

Accepted for mailing at special rate of postage provided for in section 412, Act of February 28, 1925, authorized on March 14, 1928.

POTATO APHID CONTROL STUDIES, 1946-1949, AT WOODSTOCK, N. B., CANADA[1]

J. B. Adams and R. A. Kelley

Dominion Entomological Laboratory, Fredericton, N. B., Canada

Aphid Conditions in New Brunswick

(Accepted for publication, January 15, 1950)

The potato plantings of New Brunswick are normally approximately 65,000 acres. A very large percentage of this production is concerned with the seed trade, and consequently healthy tubers are the outstanding requirement. Potatoes are grown along the St. John River valley in an area common in part to Aroostook County, Maine. In the northern and western sections of the Province conditions differ somewhat, but all areas have certain insects in common, the outstanding ones being aphids.

As in Maine, there are four species of aphids attacking the potato, namely, the potato aphid, *Macrosiphum solanifolii* (Ashm.); the buckthorn aphid, *Aphis abbreviata* (Patch); the green peach aphid, *Myzus persicae* (Sulz);

---

[1]Contribution No. 2650 Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

[2]Officer-in-charge.

[3]Technical Officer.

and the foxglove aphid, *Myzus convolvuli* (Kltb.). Flea beetles, the Colorado potato beetle, and leafhoppers are the other important insects pests.

Records accumulated since 1934 indicate that in the average year aphids of all four species are normally distributed throughout the potato fields by the end of the first week in July. On a standard variety such as Katahdin, the build-up of infestation is slow in July, but from the July nucleus enormous populations are developed in August, if aphid production be allowed to continue without control.

The actual loss in yield due to aphid feeding had been difficult to demonstrate until an aphicide as effective as DDT became available. Increases in yields from plots sprayed with DDT as compared with those from checks on which only beetles had been controlled, ranged from 16 to 25 per cent from 1947 to 1949. Differences, of course, were most noticeable in years of high aphid numbers. For example, in 1947, on approximately 1,000 compound leaves examined after the last week in July the total aphid population in check plots was in excess of 85,000 insects. During the same period in 1949, the corresponding number was greater than 235,000. With populations of even the lesser of these, serious foliage injury has occurred in Katahdin. This injury has consisted of rosetting of the terminal growth, shortening of the inter-nodal areas, blackening of the veins, and leaf drop (Adams, 1946, pp 5, 11 and 14). Such destruction or abcission of the foliage would naturally be reflected in the yield of tubers.

Maturation of host plants and other ecological factors encourage the sloughing off of aphid populations from approximately the last week in August. By mid-September infestations on potatoes have almost disappeared. Hence the control of aphids on potatoes is a problem facing the grower for at least eight weeks, and to this can be added the need to control beetles and disease. In other words, if weekly applications of an insecticide are considered advisable, at least eight applications would be necessary for protection throughout the season. For most growers this is a very great drain on finances.

Coincident with these aphid conditions appears to be the spread of the aphid-borne leafroll virus which has been materially limited in recent years by the practices of early harvest, the use of clean seed stock, and the control of aphid populations.

Experimental Procedure

The following experiments were designed to evaluate the control of leafroll obtained by the control of aphids alone without the chemical destruction of foliage at an early date in the growing season.

To simulate actual commercial conditions all experiments discussed in this paper were conducted on a typical potato farm in the St. John valley. Woodstock is on the edge of the potato area, and the potato season is somewhat earlier there than at sites farther up the river. Plots consisted of 12

rows (except in 1946, then 16) 110 feet long; in all, approximately 20 acres were under spray test each season and each experiment was of a Latin square design. All experimental fields were planted with Katahdin. Foundation grade, seed potatoes.

Plots were separated by nine-foot oat barriers laterally and by forty-foot fallow headlands terminally.

In 1947, 1948, and 1949, 200 tubers were taken from each plot at harvest time for winter testing for leafroll. In addition, tuber samples were taken in 1949, at fixed dates within the spray season.

Experimental Results

1946—Under the direction of officers from headquarters in Ottawa, an experiment was designed to test the efficiency of DDT as an aphicide at different periods in the season and in two, three, and four applications.

Table 1 shows the mortalities from such treatments

Table 1—*Comparative effectiveness in the control of potato aphids obtained by different numbers and periods of applications of DDT-tribasic copper sulphate, at Woodstock, N. B.*

No. of Applications	Dates of Applications	Per cent Aphid Mortality	
		September 5	September 9
Four	July 19, 29, August 6, 15	86	75
	July 29, August 6, 15, 23	98	97
	August 6, 15, 23, September 3	99	99
	August 15, 23 September 3, 12	99	99
Three	July 19, 29, August 6	67	51
	July 29, August 6, 15	87	74
	August 6, 15, 23	97	94
	August 15, 23, September 3	99	99
Two	July 19, 29	59	49
	July 29, August 6	60	48
	August 6, 15	83	64
	August 15, 23	97	93

Table 1 shows that the critical period is between the 6th of August and the 3d of September, and even three sprays applied during that period will give 99 per cent mortality. Even two sprays on the 19th and 29th of July gave approximately 50 per cent mortality, although at that time in July aphid populations were very low. As was mentioned previously, the greatest increase in aphid numbers becomes apparent in August, and these July sprays were applied before the build-up in numbers became very noticeable. This degree of control seems to be the result of retarded establishment. Regrettably, no tubers were re-grown to determine leafroll incidence in the different treatments at the end of the 1946 season.

Although yields from the various treatments were not significantly different, the trends indicated that the three and four applications of DDT and copper in August each increased the weight of tubers by as much as one-third as compared with the yield from check plots.

1947.—In 1947, based on facts learned from the 1946 tests, an experiment was designed to find the most effective period over which to apply four treatments as a means of controlling the leafroll vector, the aphid. To determine this, the spray season was divided into periods called early-, mid-, and late-season; and the results were compared with those from checks not treated for aphid control, and those from plots sprayed throughout the season.

In effect, "early-season" sprays consisted of four sprays at weekly intervals beginning when the first aphids were noted in the area, that is early in the first week in July. These were overlapped at the third application by the "mid-season" sprays, which began the 20th of July. In turn these mid-season treatments carried on for four weeks and were overlapped on the third application by the beginning of the "late-season" treatment about the 10th of August. The latter treatment continued until the end of the season, when plots were top-killed. The "all-season" treatment involved applications at weekly intervals from the beginning of the early schedule until top-killing.

The results of this experiment are given in table 2. An analysis of aphid populations has been confined to the period after the 22nd of August. Prior to that time the distribution in the field was spotty and samples were of very small size.

TABLE 2.— *Incidence of aphids and aphid-borne leafroll in plots sprayed with DDT emulsion at different periods, Woodstock, N. B. 1947.*

Period of Application[1]	Aphid Populations[2]					Per cent Aphid Mortality	Yield in Pounds	Per cent Leafroll
	Aug. 22	Sept. 5	Sept. 12	Sept. 17	Total[3]			
All-season	18	3	0	5	26	99.9	10858.	0.48
Late-season	4931	301	163	235	5630	93.6	10694.	0.12
Mid-season	142	21	727	145	1035	98.8	11012.	0.14
Early-season	35	356	2651	3508	6550	92.5	10453.	0.22
Check	2891	16994	30444	36957	87286	....	9146.	0.12

[1]All-season—Sprayed July 11, 16, 24, 30; August 2, 7, 12, 16, 31, 27; September 1, 6, 10, 15.
Late-season—Sprayed August 27; September 1, 6, 10, 15.
Mid-season—Sprayed August 7, 12, 16, 21, 27.
Early-season—Sprayed July 11, 16, 24, 30; August 2.

[2]Aphid populations are total aphids, all species, from 150 compound leaves from each treatment at each date.

[3]Least significant difference at the one per cent level=6987.

TABLE 3.—*Incidence of aphids and aphid-borne leafroll in plots sprayed with DDT emulsion at different periods, Woodstock, N. B. 1948.*

Period of Application[1]	Aphid Populations[2]							Per cent Mortality	Yield in Pounds per Treatment	Per cent Leafroll
	July 30	Aug. 5	Aug. 14	Aug. 19	Aug. 26	Sept. 2	Total[3]			
All-season	2	4	1	1	8	8	24	99.9	7283	3.6
Late-season	105	57	21	2	5	11	201	99.6	7909	7.9
Mid-season	12	5	10	9	85	112	233	99.5	7004	0.5
Early-season	1	41	59	266	2691	6080	9138	82.2	7395	4.2
Check	188	256	1199	2025	7217	30135	51020	....	7483	5.5

[1]All-season—sprayed July 7, 14, 21, 29; August 4, 12, 18, 24 and September 1.
Late-season—sprayed August 4, 12, 18, 24 and September 1.
Mid-season—sprayed July 21, 29; August 4, 12.
Early-season—sprayed July 7, 14, 21, 29.
Check—sprayed only with calcium arsenate and basic copper.
[2]Aphid populations are total aphids, all species, from 150 compound leaves from each treatment for each date.
[3]Least significant difference at the one per cent level=10666 aphids.

TABLE 4.—*Incidence of aphids and aphid-borne leafroll in plots sprayed with DDT emulsion at different periods, Woodstock, N. B. 1948.*

Period of Application[1]	Aphid Populations[2]							Per cent Mortality	Yield in Pounds per Treatment	Per cent Leafroll
	Aug. 1	Aug. 9	Aug. 16	Aug. 22	Aug. 31	Sept. 7	Total[3]			
All-season	995	1327	492	233	359	436	3842	98.4	8307	0
Late-season	2637	2462	716	305	463	329	6912	97.1	8383	1
Mid-season	897	1734	388	586	2037	1759	7401	96.4	8187	1
Early-season	847	2682	6509	7627	24234	43454	85353	63.3	6630	1
Check	2707	10336	17588	36912	72125	96024	234710	....	6277	1

[1]All-season—sprayed July 5, 12, 26; August 2, 10, 16, 23, 31; September 9.
Late-season—sprayed August 16, 23, 31; September 9.
Mid-season—sprayed July 26; August 2, 10, 16.
Early-season—sprayed July 5, 12, 20, 26.
Check—sprayed only with calcium arsenate and basic copper.
[2]Aphid populations are total aphids, all species, from 150 compound leaves from each treatment for each date.
[3]Least significant difference at the one per cent level=11095 aphids.

The results leave little doubt that all species of aphids on potatoes can be controlled efficiently, under the conditions of this experiment, by the use of DDT emulsion. The time of applications was of particular importance, and again those sprays applied in August were the most efficient in limiting populations although no significant differences could be noted within spray treatment when all were compared with the checks. The goal in this experiment was to eliminate populations if possible, on the presumption that leafroll spread would also be eliminated. The all-season and mid-season schedules most nearly fulfilled the requirement as far as aphid populations are concerned, although both treatments contained as much leafroll at the end of the season as did the untreated check.

Yields from the check plots differed significantly from those of the sprayed plots, being approximately 14 per cent less. No significant differences were found between yields from treated plots.

1948.—Because of the unexpected records of leafroll incidence which were obtained in 1947, the experiment was repeated in 1948. Conditions were as nearly similar as the available area would permit.

The results of this experiment are given in table 3. In 1948, establishment was more uniform, and appreciable populations were present in the plots by the 30th of July.

As in 1947, aphid control was excellent in all treatments except the early ones. Even in those, populations were materially limited. The leafroll data reveal that the incidence of leafroll was as great in treated plots as in the untreated checks. There was also a highly significant difference between columns in a Latin square analysis. Therefore it appears that the distribution of leafroll in the field was not controlled by the reduction in aphid population but was, rather, the reflection of other factors.

Apparently because of the relatively light aphid infestation throughout the season, yields from the various treated plots were not significantly better than those from the untreated checks.

1949.—In 1949, the experiment was set up for a third year. To increase the chances of leafroll spread within the plots, hills planted with leafroll-infested tubers were placed in similar positions across the centre of each twelve-row plot. At the conclusion of each treatment, sample tubers were taken from hills on each side of these diseased plants. At the end of the season standard tuber samples were taken as in previous years. Table 4 illustrates the degree of aphid and leafroll control obtained in 1949.

As in previous years, aphid populations in the treated plots were significantly lower than those in check plots. In regard to leafroll there were no significant differences between treatments and check plots.

In 1949, there was a very severe aphid infestation, and yields from plots

treated with DDT were as much as 25 per cent above those from the checks. All-season, late-season, and mid-season treatments gave significantly better yields than did the early-season and check treatments.

TABLE 5.—*Summary of the aphid mortality obtained with DDT emulsion over a four-year period, 1946 to 1949, at Woodstock, N. B.*

	Per cent Mortality			
Treatment	1946	1947	1948	1949
All-season	99	99.9	99.9	98.4
Late-season	99	93.6	99.6	97.1
Mid-season	97	98.8	99.5	96.4
Early-season	75	92.5	82.2	63.3
Check, total aphids	....	87286± 6987	51020± 6132	235710± 11095

DISCUSSION

During experiments conducted over four years it was determined that aphids on potatoes in New Brunswick could be controlled efficiently by the use of DDT emulsion sprays, and that yields could be increased as much as 25 per cent. Yield increases, of course, were influenced to a very great extent by the density and period of aphid infestation. Table 5 summarizes the control obtained during the seasons of experiment.

In the years of the study, the behavior of the population of *Myzus persicae* (Sulzer) was typical of that of the total population at most dates.

When aphid control to the extent of 99 per cent was obtained it was expected that significant reductions in the amount of leafroll would have resulted. These have not followed. As much leafroll has appeared in plots sprayed all season as appeared in the check or unsprayed areas. In part, this may be the result of the feeding of aphids dispersing from surrounding areas, from the check plots of these experiments as well as from outside fields. This feeding may take place between DDT sprays at a time when the residual effect of the poison has diminished, and at a time when potato foliage is developing so rapidly that unsprayed leaves are constantly appearing in all plots.

This is not to suggest that the use of DDT over a great portion of the potato-growing area has not limited leafroll-spread to a considerable degree. It has been possible during 1948 and 1949 to raise Foundation grade seed potatoes at the Woodstock research station, by a combination of isolation, good seed, weekly DDT-spraying, and early top-killing and harvest.

It does show, however, that as long as it remains impossible to keep

foliage completely covered with an insecticide it will be impossible to eliminate leafroll. Elimination of leafroll should only be expected when means are found to supply all plants with a way of protecting themslves. This leads directly to the use of systematic insecticides in some form or to the development of insect- and disease-resistant plants.

From studies on aphid resistance carried out prior to 1946, it was pointed out that the utilization of such native resistance was a logical line to pursue, and the results obtained since that time have only supported the belief that every effort should be made to develop aphid resistance in the commercial potato.

It appears that whatever the recommendations for the future may be, control of leafroll spread by aphids can only be affected if one or more of the following conditions be met:

(1) that there be developed a potato variety highly resistant to aphid feeding and the development of winged forms (dispersal forms);

(2) that such a resistant variety preferably possess a material degree of resistance of leafroll itself;

(3) that there be developed a systematic insecticide with general foliage repellence for the aphids but no tuber toxicity;

(4) or that an insecticide of the efficiency of DDT emulsion be used on *all* potatoes over wide areas and that all potato planting be from elite seed.

Literature Cited

1. Adams, J. B. 1946. Aphid resistance in potatoes. Amer. Potato Jour. 23(1):1-22.

THE EFFECTIVENESS OF CERTAIN ANTIDOTES IN COUNTERACTING THE OFF-FLAVOR IN POTATOES GROWN ON SOIL TREATED WITH BENZENE HEXACHLORIDE

Margaret H. Harvey, Mary L. Greenwood

School of Home Economics, Storrs Agricultural Experiment Station, University of Connecticut, Storrs, Conn.

and

Neely Turner

Department of Entomology, Connecticut Agricultural Experiment Station, New Haven, Conn.

(Accepted for publication, January 15, 1950)

Soil that has been treated with benzene hexachloride for the control of wireworms has been found to produce potatoes, with a characteristic, unpleasant flavor for a period of three years after application. The Connecticut Agricultural Experiment Station at New Haven, in 1949, tested several

compounds, as applied to benzene hexachloride-treated soil, for their antidotal effects on this off-flavor. The compounds tested were activated charcoal (Norite), alcoholic potash, lime-sulfur, ferric chloride, and lime. Each antidote was applied to the soil before the potatoes were planted. Palatability tests on the antidotal effects of these compounds were carried out by the School of Home Economics of the University of Connecticut.

Procedure

The antidotes were applied in the spring of 1949 to soils treated in the spring of 1948 with two pounds per acre of benzene hexachloride (Turner, 1950). A rototiller was used for thorough mixing.

The activated charcoal and the ferric chloride were applied at the rate of one ton per acre; the alcoholic potash at one-half gallon (.1 Normal) per 60 square feet; and the lime at five tons per acre. The liquid lime-sulfur was applied at two different levels, namely, 25 pounds and 12½ pounds per acre, respectively. To serve as a check, a plot of soil without benzene hexachloride was treated with 50 pounds lime-sulfur per acre. Potatoes were grown also on untreated soil and on unantidoted benzene hexachloride-treated soil. The Katahdin variety was used in all tests.

Preliminary Tests

Preliminary taste tests were conducted with a panel of sensitive tasters. Those persons who could detect a distinct off-flavor in potatoes grown on soil treated with two pounds of benzene hexachloride per acre were included. In all cases the potatoes were boiled with the jackets on, mashed and offered without seasoning. The samples of potatoes grown in soil with antidoting treatments were compared only with normal potatoes grown in untreated soil. This test was designed to catch off-flavors rather than to compare relative amounts of off-flavor.

Large Scale Tests

Six taste tests were conducted on samples of potatoes from these plantings as noted in table 1. Each taste test (with the exception of those involving lime-sulfur) included duplicate samples of the antidoted potatoes, two of the unantidoted benzene hexachloride potatoes, and two of the potatoes grown on untreated soil. The samples were presented in random order. The total number of samples presented in any one test ranged from five to eight. In the case of the lime-sulfur tests, involving several dosages, all samples were presented singly. To aid the taster in identifying the off-flavor due to benzene hexachloride, reference samples, identified as untreated and unantidoted benzene hexachloride-treated, were presented. In tests 2, 3, and 4, the benzene hexachloride-treated reference sample was omitted.

A score sheet was provided for recording the degree of intensity (+, ++, +++, etc.) or the absence (—) of benzene hexachloride off-flavor. Any other off-flavors which might have arisen from the antidotal compounds were recorded in the second column. The number of tasters for single tests varied from 23 to 37.

The potatoes were baked at 425° F. for approximately one hour or until tender as determined by a cake tester. Previous to baking they were punctured with a fork to prevent bursting from steam pressure. After baking, the potatoes were quartered and the contents removed with a spoon. Each sample to be tasted was made up of one-quarter of each of twelve potatoes from a given treatment. The twelve quarters of potatoes on each plate were mashed and mixed with a fork.

TABLE 1—*Antidotes used to counteract the off-flavor in potatoes grown on benzene hexachloride-treated soil.*

Compound	Levels of Treatment	Test Numbers	Number of Tasters
Activated charcoal	1 ton per acre	1	30
		2	23
		3	28
Lime	5 tons per acre	2	23
		3	28
Alcoholic potash (0.1 normal)	1 ton per acre	4	28
Ferric chloride	½ gal. per 60 sq. ft.	4	28
Lime-sulfur	12½ and 25 lbs. per acre	5	27
		6	37

Several methods of interpretation might be applied to data of this nature. In the present experiment the information given on the score sheets by the tasters was transformed into scores for ordinal data, as given by Fisher and Yates (1948). The lowest score was assigned to the samples indicated as having the least or no off-flavor. Tied values were averaged. The analysis of variance was used to aid in the interpretation of the data.

The "sensitive" tasters, selected for certain of the tests, were those who correctly identified at least three of the four untreated and unantidoted benzene hexachloride samples (two of each). In the remaining tests, involving lime-sulfur at different levels, in which there was no duplication of samples, a "sensitive" taster was defined as one who detected the off-flavor in the unantidoted benzene hexachloride potatoes and also gave a negative sign to the untreated sample.

RESULTS

Preliminary Tests

Results of the preliminary tests were as follows:

Antidote	No. of Tasters	No. of Tasters Finding an Off-flavor
Activated charcoal	9	0
	11	5
	11	7
	12	7
Lime	8	3
	10	6
	8	5
Alcoholic potash	8	8
Ferric chloride	9	7
Lime—sulfur (12.5 lbs. per acre)	9	9
(25 lbs. per acre)	11	11
(50 lbs. per acre)	11	11

None of the treatments seemed to remove the off-flavor entirely in these tests. In addition to the data given here there was some further evidence. The off-flavor following the activated charcoal antidote was very slight when any was detected at all. These potatoes were palatable. Likewise potatoes grown in lime treatment were palatable. Alcoholic potash had some effect, but the sensitive tasters found a definite benzene hexachloride flavor. Lime-sulfur and ferric chloride were not effective.

Large Scale Tests

Activated Charcoal: The tests carried out on potatoes grown on soil antidoted with activated charcoal indicate that this compound is definitely effective in counteracting the benzene hexachloride off-flavor as shown in table 2. It can be seen from the totals in table 2 that in five of the six total scores (for all the tasters and for the "sensitive" tasters) the scores for the activated charcoal potatoes were significantly smaller than for the unantidoted potatoes. That the off-flavor of benzene hexachloride was not completely eliminated is indicated by the significant difference between the total scores for the untreated and the antidoted potatoes, except in test 2. No off-flavor seemed to be imparted to the potatoes by the activated charcoal. However, some tasters commented that the potatoes were "flat" or lacking in flavor.

Alcoholic Potash: In the single test with alcoholic potash, corrective properties were indicated for this antidote. The total scores, as you will note in table 3. for the alcoholic potash potatoes, were significantly less than for the unantidoted potatoes. However, some of the flavor of the benzene hexachloride apparently remained as indicated by the still lower figures for the untreated potatoes. Though the differences here were not large enough to be

statistically significant the preliminary test (carried out at New Haven) showed that the benzene hexachloride flavor was still present. The alcoholic potash did not impart any off-flavor to the potatoes.

TABLE 2—*Total scores showing the effectiveness of activated charcoal and lime in antidoting the off-flavor of potatoes grown an benzene hexachloride-treated soil*

		Total Scores of Different Treatments[1]			
			Benzene hexachloride, 2 Lbs. per Acre		
Test No.	No. of Tasters	No Treatment	Activated Charcoal	Lime	No. Antidote
1 All tasters	30	—15.81	+2.29	....	+13.74
2 All tasters	23	—13.23	—8.94	+13.22	+8.76
3 All tasters	28	—15.45	+5.34	+6.86	+3.16
1 Sensitive tasters	8	—10.88	—.97	....	+11.82
2 Sensitive tasters	13	—13.86	—8.16	+12.70	+9.27
3 Sensitive tasters	13	—13.31	+2.86	—.21	+10.52

[1] Total scores for all tests differ significantly ($P<0.01$) except in Test No. 3 using all the tasters scores.

TABLE 3—*Total scores showing the effectiveness of alcoholic potash and ferric chloride in antidoting the off-flavor of potatoes grown on benzene hexachloride-treated soil.*

		Total Scores of Different Treatments[1]							
				Benzene hexachloride, 2 Lbs. per Acre					
Test No.	No. of Tasters	No Treatment		Alcoholic Potash[2]		Ferric Chloride		No Antidote	
4 All tasters	28	—4.73	—12.68	—5.43	—5.31	+12.29	—1.65	+8.11	— .55
4 Sensitive tasters	14	—5.41	— 9.54	—2.96	—4.15	+ 8.57	+2.09	+8.11	+3.29

[1] Total scores differ significantly ($P<0.01$).

[2] The lack of difference in these values is real; the scores given by the individual tasters for the two samples are generally similar.

Lime-Sulfur: Lime-sulfur was partially effective as an antidote for a benzene hexachloride off-flavor in potatoes, as you will note in tests 5 and 6

in table 4. The lime-sulfur at 25 pounds per acre was effective in counteracting the off-flavor, but at the 12½ pounds level it had little effect, as shown by the comparison of the total scores for these potatoes with both the untreated and with the unantidoted potatoes.

TABLE 4—*Total scores showing the effectiveness of lime-sulfur in antidoting the off-flavor of potatoes grown on benzene hexachloride-treated soil.*

		Total Scores of Different Treatments[1]				
			Benzene hexachloride, 2 Lbs. per Acre			
			Lime-Sulfur			
Test No.	No. of Tasters	No Treatment	50 lbs. per Acre	25 lbs. per Acre	12½ lbs. per Acre	No Antidote
5 All tasters	27	—3.02	—7.48	—4.99	+14.57	+1.03
6 All tasters	37	—12.91	—5.19	—4.10	+6.86	+15.47
5 Sensitive tasters	11	—7.85	—3.37	—4.29	+8.83	+6.73
6 Sensitive tasters	19	—14.92	—2.38	+.39	+3.45	+13.52

[1]Total scores differ significantly ($P<0.01$).

TABLE 5—*Total scores showing the degree of off-flavor other than benzene hexachloride imparted to potatoes grown on soil treated with lime-sulfur.*

		Total Scores of Different Treatments				
			Benzene hexachloride, 2 Lbs. per Acre			
				Lime-Sulfur		
Test No.	No. of Tasters	No Treatments	No Antidote	12½ lbs. per Acre	25 lbs. per Acre	50 lbs. per Acre
5 All tasters[1]	27	—1.68	+2.12	+.59	—2.82	+1.83
6 All tasters[2]	37	—4.57	—.79	+4.54	—6.20	+7.18
5 Sensitive tasters[3]	7	—3.91	—2.53	+.98	—1.45	+6.90
6 Sensitive tasters[4]	11	—5.38	—3.39	+1.69	—2.34	+9.45

[1]Difference of total scores not significant ($P<0.10$).
[2]Total scores differ significantly ($P<0.05$).
[3]Difference of total scores not significant ($P<0.10$).
[4]Total scores differ significantly ($P<0.01$).

Table 5 shows the scores given by the tasters for the presence of an off-flavor other than benzene hexachloride in the lime-sulfur potatoes. At the 12½ and 25-pound levels some off-flavor was noted, but results are inconsistent. At the 50-pound level the lime-sulfur off-flavor was definite.

Lime: There is little evidence that lime as an antidote is effective for the benzene hexachloride off-flavor as shown in table 2. Only in test 3 were the scores given by the "sensitive" tasters significantly less for the lime potatoes than for the unantidoted potatoes. In general, the lime seemed to impart an off-flavor for some tasters. This off-flavor was described most often as "earthy."

Ferric chloride: Ferric chloride displayed no corrective properties for the characteristic benzene hexachloride off-flavor. The results of test 4, given in table 3, were inconsistent and inconclusive. Both with the ferric chloride-treated duplicates and with the benzene hexachloride duplicates the total scores varied widely and are therefore presented separately. This may indicate that the tasters confused the two off-flavors. Some of the tasters reported that the ferric chloride potatoes had a bitter, chemical flavor.

Conclusions

Activated charcoal (1 ton per acre), when applied to benzene hexachloride-treated soil, showed a definite ability to counteract the characteristic off-flavor of benzene hexachloride in potatoes. It did not impart any off-flavor of its own to the potatoes.

Alcoholic potash (½ gal., 0.1 N, per 60 sq. ft.) showed incomplete corrective properties. It did not impart an off-flavor of its own to the potatoes.

Lime-sulfur, at the 25 lbs. per acre level, had some antidotal effect, but it imparted an off-flavor to the potatoes which would make its use objectionable.

Lime (5 tons per acre) and ferric chloride (1 ton per acre) were not effective as antidotes, and in addition, they imparted an objectionable off-flavor to the potatoes.

Acknowledgment

The authors acknowledge the aid of C. I. Bliss, Biometrician, Connecticut Agricultural Experiment Station; Martha Potgieter, Associate Professor of Foods and Nutrition, University of Connecticut; and all the subjects who acted as tasters throughout the experiment.

Literature Cited

1. Fisher, R. A. and F. Yates 1948. Statistical Tables for Biological, Agricultural and Medical Research Third ed. Hafner Publishing Co., New York.
2. Turner, Neely 1950. Counteracting the effect of benzene hexachloride in causing off-flavor in potatoes. Jour. Econ. Ent. 42: (In Press).

FACTORS CONTRIBUTING TO THE UTILITY AS FOOD OF FIVE GRADES OF MICHIGAN POTATOES[1]

PAULINE PAUL, BETTY IVES COLE AND KATHERINE G. KNIGHT

Department of Foods and Nutrition, Michigan State College, East Lansing, Mich.

(Accepted for publication, March 9, 1950)

There is considerable interest in factors which affect the sale of potatoes, since the per capita consumption of potatoes has decreased steadily for a number of years despite the fact that potatoes are a low cost food of significant nutritive value. Investigations by the Bureau of Agricultural Economics (1) have shown that consumers are not well informed regarding the meaning of grades of potatoes. This study was planned to measure consumer response to a situation where several grades of the same variety of potatoes were available in the same market. Laboratory tests were made on samples purchased from these grades, to give an estimate of quality to which consumer reactions could be compared. The results of the laboratory tests are reported in this paper.

Studies of consumer reactions to potatoes indicate that there is a "wide public demand for clean potatoes of high quality" (2). According to Hotchkiss, Wood and Findlen (7) the most important factors in determining cooking quality are (1) mealiness, (2) whiteness, (3) lack of sloughing. Cravens (6) found that price was an important factor in the purchase of Michigan potatoes. Several studies (2, 4, 6, 14) have emphasized the importance of uniformity of size and absence of defects.

EXPERIMENTAL PROCEDURE

Selection of Samples:

Well matured Menominee potatoes grown on one farm were used.[2] These were graded according to United States Department of Agriculture standards, packed in 15-pound paper bags and sold for a 12-week period through stores in Lansing and East Lansing. Samples were purchased from the stores in the same manner as a housewife would buy her supply of potatoes. There were nine purchase periods during the period from the 19th of December, 1947 to the 15th of March, 1948.

Grades

The five grades of Menominee potatoes were: (1) U. S. No. 1, size A, meeting the requirements of the Michigan Potato Development Association, (referred to in this paper as U. S. No. 1—M.P.D.A.); (2) U. S. No. 1;

[1] Journal article No. 1130 from the Michigan Agricultural Experiment Station.

[2] The potatoes were obtained through the cooperation of Dr. M. E. Cravens, Jr., Agricultural Economics and Mr. L. V. Nelson, Farm Crops.

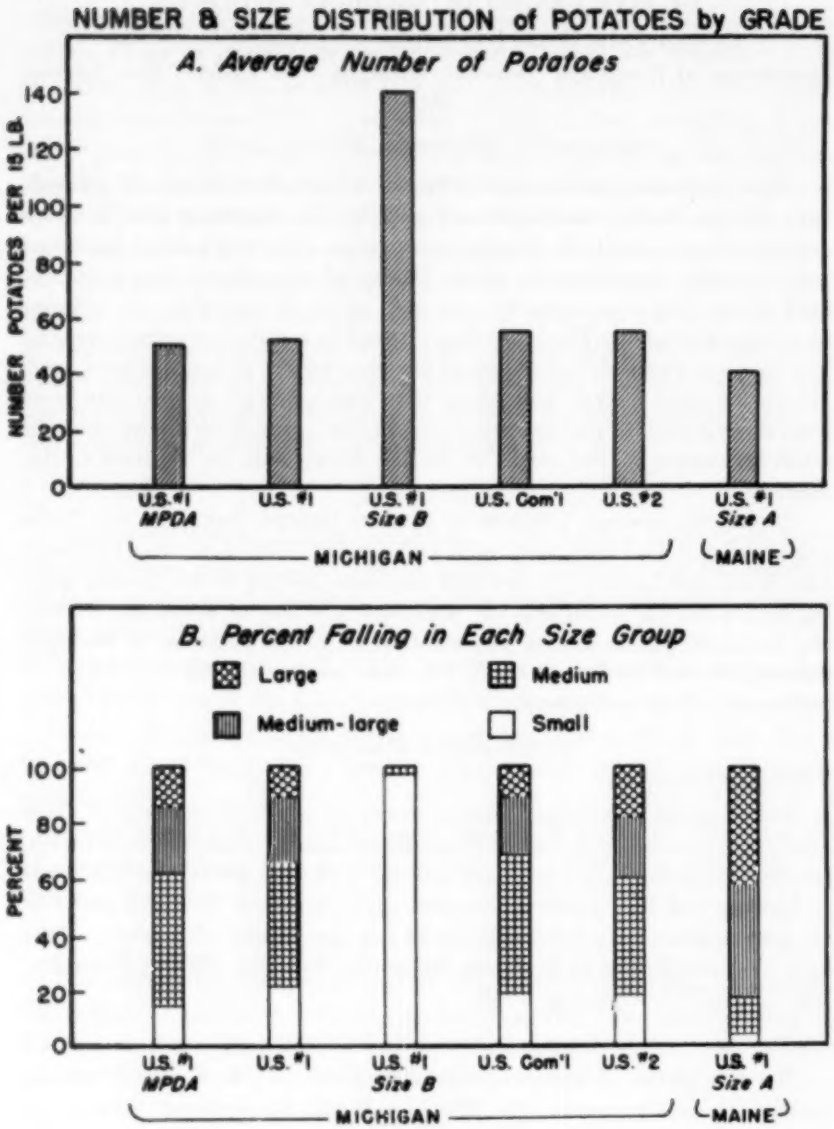


Fig. 1. Average number of potatoes, and size distribution.

(3) U. S. No. 1—size B; (4) U. S. Commercial; and (5) U. S. No. 2. Whenever possible, one peck of each grade was purchased at each purchase period. However, all grades were not always available. Also, some of the samples were damaged by too low storage temperature prior to purchase. These were discarded as soon as the injury was detected. At each purchase period a bag of Chippewa or Katahdin potatoes, U. S. No. 1—size A grade, from Maine was obtained for the purpose of comparison.

All the grades of the Michigan and the Maine potatoes were used in all the tests except cooking. The U. S. No. 1—M.P.D.A., the U. S. No. 1—size B, and the U. S. No. 2 grades of Michigan potatoes, and the Maine potatoes, were used for the cooking tests.

Physical Tests

The potatoes from each peck were sorted into four size groups as follows: (1) small, under 2″ x 2¼″; (2) medium, 2¼″ x 2½″; (3) medium-large, 2¾″ x 3″; and (4) large, over 2⅞″ x 3½″. The weight and the number of potatoes in each group were recorded. The tubers were then divided into thirds by random selection. One-third was tested the day after purchase, one-third after storage for one week, and one-third after storage for two weeks.

The tubers for the storage tests were kept in a closed cupboard in the laboratory. The average room temperature was 77 degrees F. and the relative humidity ranged between 30 and 65 per cent during the tests.

The samples for each test period were scrubbed, dried, and tested for specific gravity according to the method given by Clark, Lombard, and Whiteman (5), using salt solutions having densities of 1.070, 1.080, 1.090 and 1.100. The lowest density solution in which each tuber floated was recorded as the specific gravity for that tuber.

Chemical Tests

The chemical tests were made on raw, unpeeled potatoes. Four potatoes were selected at random and a quarter removed from each by cutting the potato lengthwise. These sectors were cut crosswise into one-fourth inch pieces and mixed thoroughly. The reduced ascorbic acid determinations were made according to the method described by Loeffler and Ponting (9). Total solids were determined by drying finely chopped samples for 48 hours at 70 degrees C. in an oven having forced draft ventilation. The sugar content was checked by the picric acid color test described by Peacock and Brunstetter (13) to determine the suitability of the tubers for deep fat frying.

Cooking Tests[*]

The potatoes which were cooked for organoleptic scoring were prepared by boiling, mashing and baking. A panel of five trained judges scored the

[*] The assistance of Elaine Hudson in preparing the samples for scoring is gratefully acknowledged.

samples for appearance, odor, flavor, texture, and general conclusion. The scores ranged from one (very poor) to seven (excellent). Standard procedures were followed in the preparation of the potatoes for scoring. All samples were presented to the judges while they were still hot. Records of waste in preparation were kept on the potatoes that were peeled for the boiled and mashed samples.

Discussion of Results

Price

The prices paid for the potatoes are given in table 1. The highest price was paid for the Maine potatoes and the lowest for the smallest potatoes, U. S. No. 1—size B. The price of the other samples decreased with the grade. Calculation of the cost of the edible portion of the potatoes did not change this order.

Size

The average number of potatoes per peck, and the size distribution for each grade are shown in figure 1. The U. S. No. 1—size B averaged 140 potatoes per peck, the Maine potatoes averaged 41, whereas the other four grades of Michigan potatoes averaged between 51 and 56 potatoes per peck.

The weight ranges found for each size classification were: small: 35 to 79 grams per potato; medium, 85 to 122 grams; medium-large, 143 to 186 grams; large, 207 to 330 grams. The U. S. No. 1—size B grade was made up almost entirely of small potatoes, whereas the Maine samples had the highest proportion of medium-large and large. The other four grades were quite similar to each other in distribution of potato sizes.

Table 1—*Price in cents per pound paid for potatoes.*

Grades	Price per Pound of Potatoes as Purchased		Price per Pound of Edible Tissue*
	Average	Range	Average
MICHIGAN (15 lb. bags)			
U.S. No. 1—M.P.D.A.	4.87	Constant	5.68
U.S. No. 1	4.60	Constant	5.37
U.S. No. 1—Size B	3.21	3.00-3.27	3.97
U.S. Commercial	4.33	Constant	5.08
U.S. No. 2	3.71	3.27-3.93	4.56
MAINE			
U.S. No. 1—Size A	6.48	5.00-6.90	7.47

*Based on preparation waste as listed in Table 5.

Specific Gravity

The average specific gravities determined for the various samples of potatoes are given in table 2. The U. S. No. 1—M.P.D.A. grade had the highest average specific gravity, 1.079, whereas the U. S. No. 2 grade had the lowest, 1.074. However, all the specific gravities were very close together, and all were in the range indicative of waxy texture. Previous studies (8, 12, 15) have shown that the Menominee and Chippewa varieties tend to produce potatoes of low average specific gravity.

TABLE 2—*Average specific gravities of potato samples.*

Grade	Room Temperature Storage			
	1 Day	1 Week	2 Weeks	Average
MICHIGAN				
U.S. No. 1—M.P.D.A.	1.078	1.080	1.079	1.079
U.S. No. 1	1.076	1.077	1.079	1.077
U.S. No. 1—Size B	1.076	1.078	1.078	1.077
U.S. Commercial	1.075	1.077	1.076	1.076
U.S. No. 2	1.073	1.075	1.074	1.074
MAINE				
U.S. No. 1—Size A	1.075	1.077	1.077	1.076

The specific gravity of most of the samples increased slightly with laboratory storage. This paralleled the increase in total solids.

TABLE 3.—*Average per cent total solids for different grades of potatoes at each purchase period.*

Purchase Period	Grade					
	U.S. No. 1 M.P.D.A.	U.S. No. 1	U.S. No. 1 Size B	U.S. Com'l.	U.S. No. 2	Maine U.S. No. 1 Size A
1	22.4	21.0	21.7	20.3	22.1	20.7
2	21.1	20.6	24.8	22.2	....	20.3
3	19.5	21.1	18.2	20.3	19.5	20.0
4	20.6	19.0	20.3	19.4	16.5	20.3
5	....	20.5	20.2	19.0	19.6	20.4
6	21.1	21.5	21.8	19.3	21.3	20.9
7	21.7	19.5	19.4	20.4	19.6	19.9
8	20.4	19.4	....	20.3	20.5	19.3
9	21.5	20.7	18.6	20.8	20.2	19.0
Average	20.6	20.3	20.1	20.0	19.7	20.1

Total Solids

The average per cent total solids for each grade at each purchase period is shown in table 3. The U. S. No. 1—M.P.D.A. grade had the highest average per cent of total solids (20.6) and the U. S. No. 2 grade the lowest (19.7). This is in keeping with the finding that the U. S. No. 1—M.P.D.A. grade had the highest average specific gravity and the U. S. No. 2 grade the lowest.

An analysis of variance attributable to purchase, grade, and laboratory storage showed that the differences in per cent total solids because of the purchase period were highly significant, but differences due to grade or laboratory storage were not significant.

Ascorbic Acid

Table 4 gives the results of the ascorbic acid determinations, calculated on both the wet and dry basis. The average ascorbic acid values ranged from 54 to 80 per cent of the general figure of 17 mgs. per 100 gm. listed in the Tables of Food Composition (3). Only two of the samples tested reached or exceeded 17 mgs. Other investigators (10, 11) have reported the Chippewa potato as low in ascorbic acid compared to other varieties. However, when the volume of potatoes consumed is considered, they still remain an important source of vitamin C, especially in the low-cost diet.

The U. S. No. 1—size B grade of potatoes contained the greatest amount of ascorbic acid. This is in accordance with the smaller size, and relatively greater surface area of these potatoes, since it is recognized that there is a higher concentration of ascorbic acid in the portion just under the skin than in the center of the potato. The differences in ascorbic acid concentration among the various grades were highly significant ($p<0.01$).

In most cases, the ascorbic acid content decreased with storage after pur-

TABLE 4.—*Ascorbic acid content of different grades of potatoes (mg. per 100 gm.)*

Room Temperature Storage	Grade					
	U.S. No. 1 M.P.D.A.	U.S. No. 1	U.S. No. 1 Size B	U.S. Com'l.	U.S. No. 2	Maine U.S. No. 1 Size A
WET BASIS						
1 day	12.3	13.1	13.0	11.5	10.7	10.1
1 week	12.3	10.9	13.6	10.3	10.1	10.3
2 weeks	9.6	10.6	12.0	9.3	9.2	9.9
DRY BASIS						
1 day	57.0	61.9	62.4	54.3	55.5	50.0
1 week	56.9	52.6	63.0	50.7	47.7	51.2
2 weeks	49.4	51.8	65.2	41.9	39.9	49.3

chase, the difference being highly significant. However, this trend was partially reversed for the Maine and the U.S. No. 1—size B grade, the ascorbic acid content being higher after 1 week storage, than decreasing. On the dry basis, the ascorbic acid content of the U.S. No. 1—size B increased with laboratory storage. However, the high ascorbic acid figure at 2 weeks storage was associated with an unusually low total solids figure, which might reflect sampling error or an unusually high rate of respiration in this lot of potatoes.

The differences in ascorbic acid content among the samples purchased at different times during the course of the study were not significant.

Picric Acid Color Test

All the samples, including the Maine potatoes, gave a very dark picric acid color test, indicating that the sugar content was too high for their use for potato chips.

Preparation Waste

Table 5 gives the average per cent preparation waste for each grade at each storage period. The waste was greatest for the U.S. No. 1—size B grade (the smallest potatoes) and smallest for the Maine potatoes (the largest potatoes).

Factors other than size which affected the amount discarded during peeling and trimming for boiling were as follows: U.S. No. 1—M.P.D.A., hollow heart and skin blemishes; U.S. No. 1, internal rot and dark spots through the flesh of the potato; U.S. No. 1—size B, surface cuts, rot, and discoloration; U.S. commercial, surface scars, decay, and mold; U.S. No. 2, poor shape, surface cuts, hollow heart and discolored spots. The waste from the U.S. No. 2 grade was higher than from the other three grades containing potatoes of comparable size.

TABLE 5.—*Average per cent preparation waste for each grade at each storage period. (Average of 6-8 purchase periods)*

	Grade					
Storage	U.S. No. 1 M.P.D.A.	U.S. No. 1	U.S. No. 1 Size B	U.S. Com'l.	U.S. No. 2	Maine U.S. No. 1 Size A
1 day	14.3	13.5	19.0	15.8	17.6	12.7
1 week	13.5	15.0	19.8	14.9	18.9	12.6
2 weeks	14.9	14.4	18.5	13.7	19.6	14.2
Average	14.2	14.3	19.1	14.8	18.7	13.2

Palatability Scores

The average scores for the boiled, mashed and baked potatoes are shown in table 6. A complete analysis of variance was applied only to the scores from

the second, sixth, seventh and ninth purchase periods, as these were the only ones for which the data were complete.

Grades: In general, the palatability scores for the different grades of potatoes fell into two groups. The U.S. No. 1—M.P.D.A. and Maine U.S. No. 1—size A samples received very similar scores in most cases while the U.S. No. 1—size B and U.S. No. 2 potatoes were somewhat lower in score. The differences between grade groups were more pronounced for boiled and mashed potatoes than for baked potatoes.

TABLE 6.—*Average palatability scores for different grades of potatoes. (maximum score = 7)*

		Boiled				Mashed				Baked			
Scoring Factor	Room Temp. Storage	U.S. No. 1 M.P.D.A.	U.S. No. 1 Size B	U.S. No. 2	Maine U.S. No. 1—Size A	U.S. No. 1 M.P.D.A.	U.S. No. 1 Size B	U.S. No. 2	Maine U.S. No. 1—Size A	U.S. No. 1 M.P.D.A.	U.S. No. 1 Size B	U.S. No. 2	Maine U.S. No. 1—Size A
Appearance	1 day	5.3	4.8	5.0	5.5	6.1	5.1	5.5	5.8	5.5	4.8	4.9	5.8
	1 week	5.3	4.9	4.7	5.4	5.7	5.0	5.5	6.1	5.1	4.5	4.9	5.9
	2 weeks	4.8	4.7	4.7	4.7	5.5	5.0	5.2	5.2	5.0	4.5	4.9	6.0
Color	1 day	5.2	4.4	4.6	5.3	5.8	4.9	5.4	5.8	5.3	4.6	4.7	5.8
	1 week	4.7	4.0	4.3	5.0	5.4	4.5	5.1	5.9	4.8	4.3	4.8	5.7
	2 weeks	4.0	4.2	4.1	3.9	5.3	4.7	4.7	4.9	4.4	4.0	4.6	5.6
Odor	1 day	5.5	5.3	5.2	5.5	5.8	5.3	5.5	6.1	5.8	5.6	5.6	5.8
	1 week	5.5	5.3	5.4	5.6	5.7	5.4	5.6	5.7	5.9	5.6	5.4	5.6
	2 weeks	5.3	5.3	5.3	5.2	5.6	5.5	5.4	5.4	5.3	5.4	5.3	5.6
Flavor	1 day	4.7	4.3	4.4	5.4	5.1	4.0	4.4	5.5	4.8	4.4	4.3	4.7
	1 week	5.3	4.5	4.8	5.1	5.3	4.6	4.6	5.2	4.9	4.5	4.7	4.8
	2 weeks	4.8	4.9	5.0	5.0	5.1	4.9	5.0	5.1	4.5	4.5	4.3	4.6
Texture	1 day	5.0	4.6	4.8	5.2	5.3	4.4	4.7	5.6	4.9	4.4	4.4	4.9
	1 week	5.3	4.5	4.9	5.0	5.5	4.7	4.7	5.5	5.2	4.9	4.8	4.8
	2 weeks	4.8	4.7	4.8	4.8	5.3	4.8	4.7	5.2	4.6	4.3	4.2	4.7
General Conclusion	1 day	4.8	4.1	4.2	5.0	5.3	4.0	4.5	5.5	4.9	4.1	4.2	4.8
	1 week	5.0	4.1	4.5	4.8	5.4	4.4	4.6	5.4	4.9	4.3	4.5	4.9
	2 weeks	4.2	4.5	4.5	4.5	5.1	4.8	4.6	5.0	4.2	4.1	4.1	4.8

Storage: Room temperature storage affected chiefly the color of the boiled and mashed potatoes and the texture of the baked potatoes. The color of the boiled and mashed potatoes became less desirable with storage, especially during the first week. The texture of the baked potatoes improved at the end of one week of storage, but by the end of the second week the texture score had

dropped to below the original value. The Maine potatoes showed the least change in texture with storage.

Purchase Period: The differences found between samples purchased at different times reflected the changes induced by the storage conditions before the lots arrived at the retail market. The factors most affected by purchase period were: appearance for all three methods of cooking; color of boiled and mashed potatoes; odor of boiled and baked potatoes; texture of mashed and baked potatoes. The second purchase seemed to be superior for appearance and color, whereas the sixth and seventh purchases gave the best results for texture of baked potatoes. The potatoes were marketed through the regular commercial channels, and it was not possible to exercise any experimental control over the methods of handling before purchase from the store. Therefore, no explanation can be suggested for the differences or lack of differences that were observed.

Summary

Five grades of Michigan-grown potatoes and one of Maine-grown potatoes were compared for price, size, specific gravity, ascorbic acid, total solids, preparation waste, and sugar content. Three grades of the Michigan potatoes, and the Maine potatoes, were also compared for palatability. The potatoes were purchased at a retail market over a three-month period, and were tested after laboratory storage for one, seven and fourteen days. The grades of the Michigan potatoes were U.S. No. 1—M.P.D.A., U.S. No. 1, U.S. No. 1—size B, U.S. Commercial, and U.S. No. 2. The Maine potatoes were grades U.S. No. 1—size A.

The Maine potatoes were the most expensive, the Michigan U.S. No. 1—size B the least, and the other Michigan grades decreased in price as the grade dropped. The Maine potatoes were the largest, the U.S. No. 1—size B the smallest, whereas the other four grades were intermediate and all about the same in size distribution. The Maine and the U.S. No. 1—size B were the most nearly even in size distribution, with each of the other grades covering a wider range of size within each sample.

The average specific gravities of all the different lots were quite similar, and all within the range which is considered to indicate a waxy texture. The U.S. No. 1—size B contained the most ascorbic acid. In most instances, the ascorbic acid content tended to decrease with room temperature storage. The total solids content of the potatoes differed more by purchase period than by grade or storage in the laboratory. All the potatoes gave a dark color with the picric acid test, indicating too high sugar content for use in deep fat frying. The preparation waste was greatest for the U.S. No. 1—size B and least for the Maine potatoes. The U.S. No. 2 had the highest preparation waste of the other four grades.

The U.S. No. 1—M.P.D.A. and Maine potatoes were quite similar in palatability, with the U.S. No. 1—size B and U.S. No. 2 similar to each other but lower in score than the first two. The color of the boiled and mashed potatoes became less desirable with storage, whereas the texture of the baked potatoes first increased, then decreased in score.

From the standpoint of price and ascorbic acid, the U.S. No. 1—size B potatoes were the best buy. With regard to preparation waste, and palatability, the U.S. No. 1—size A Maine potatoes were superior, with the Michigan U.S. No. 1—M.P.D.A., a close second.

Literature Cited

1. Bur. of Agr. Econ. 1948. Potatoe preferences among household consumers, USDA Misc. Pub. No. 667.
2. ..... 1948. People and potatoes. USDA, AIS No. 76.
3. Bureau of Human Nutrition and Home Economics. 1945. Tables of Food Composition, USDA Misc. Pub. No. 572.
4. Baaken, H. K. 1934. Consumer preference for potatoes. Wis. Agr. Exp. Sta. Res. Bull. No. 124.
5. Clark, C. F., Lombard, P. M., and Whiteman, Elizabeth Fuller, 1940. Cooking qualities of the potato as measured by specific gravity. Amer. Potato. Jour. Vol. 17:38-45.
6. Cravens, M. E. 1947. Housewives' reactions to Michigan potatoes. Mich. Agr. Exp. Sta. Quart. Bull. 30:125-130.
7. Hotchkiss, A., M. Wood, P. Findlen, 1940. Cooking quality preferences for potatoes. Amer. Potato Jour. 17:253-262.
8. Jehle, R. A., F. J. Stevenson. 1949. The Marygold potato. Amer. Potato Jour. 26:25-32.
9. Loeffler, H. J., and Ponting, J. D. 1942. Ascorbic acid, rapid determination in fresh, frozen, or dehydrated fruits and vegetables. Ind. and Eng. Chem., Anal. Ed., Vol. 14:846-849.
10. Murphy, E. F., W. F. Dove, R. V. Akeley, 1945. Observations on genetic, physiological and environmental factors affecting the vitamin C content of Maine-grown potatoes. Amer. Potato Jour. 22:62.
11. Murphy, E. 1946. Storage conditions which affect the Vitamin C content of Maine-grown potatoes. Amer. Potato Jour. 23:197-218.
12. Nash, L. B. 1941. Potato quality. IV. Relation of variety and environmental condition to partial composition and cooking quality. Amer. Potato Jour. 18:91-99.
13. Peacock, W. M., and Brunstetter, B. C. 1931. A simple chemical test for determining the culinary quality of potatoes as affected by the accumulation of soluble sugars. Circular 158, U.S. Dept. Agr.
14. Sweetman, M. D. 1936. Factors affecting the cooking quality of potatoes. Maine Agr. Exp. Sta. Bull. No. 383.
15. Wheeler, E. J., F. J. Stevenson, H. C. Moore. 1944. The Menominee potato: a new variety resistant to common scab and late blight. Amer. Potato Jour. 21:305-311.

"POTATO PRODUCTION"

E. V. HARDENBURG

Vegetable Crops Department

Cornell University, Ithaca, N. Y.

Long years of experience and acquaintance with potato production has been recorded in a recent book entitled: "Potato Production." The author is a noted figure in the potato industry, a world authority, a great teacher and a respected advisor to several generations of potato growers. The industry will, therefore, welcome Professor Hardenburg's treatise on the "know-how" of potato growing and marketing.

As the most important vegetable grown the world over, the potato crop has commanded the attention of a large group of investigators. From their reports Professor Hardenburg has collected and analyzed the more important facts in a well organized, concise and interesting manner. The task was not an easy one as the literature on potato production is voluminous. The writer's judgment of the important facts is based upon his wide and first-hand knowledge of potato culture, storage and problems of distribution to the consuming public.

In the preface the author stated that the primary purpose for writing "Potato Production" was to provide a textbook for college students. Further, he hopes, "That it will also be of interest and use to students of secondary-school agriculture, to extension agents, commercial interests who serve the potato industry and to growers and handlers of potatoes." The reviewer heartily recommends this text as a useful addition to the libraries of those interested in the potato as a crop or commodity.

Professor Hardenburg has been identified with the potato industry since coming to Cornell in 1912 as a teacher and extension specialist. His course devoted to the theoretical and practical aspects of growing cash crops has been attended by generations of Cornell agriculture students. Professor Hardenburg's influence has gone far beyond the classroom. He is a past president, former treasurer and director of the Potato Association of America, and a frequent contributor to its journal. He was instrumental in the organization of the certified seed program in New York and was the first field inspector, a position he had for many years. The potato growers' association of New York, the Empire State Potato Club, was fostered by him as an organization to better acquaint growers with new developments in research and methods. Perhaps Professor Hardenburg is best known at the "grass roots" level as a judge of their potato displays.

It is fortunate that Professor Hardenburg found the time to devote himself to compiling under one cover the important facts and figures about potato growing and marketing. The publication of "Potato Production" is another signal achievement in a long career of service to the potato industry.

Reviewed by:
W. A. Rawlins
Professor of Entomology
Cornell University

SECTIONAL NOTES

IDAHO

The Russet Burbank will make up a greater per cent of the early plantings in western Idaho than has been true the last few years. Bliss Triumph and White Rose plantings reportedly are lower. Planting is finished in the early producing section for harvest in July and August. Late planting in this same section for fall harvest will start in mid-June and continue into July.

Sale of certified seed in the main or late region of the state has been slow. Certified growers moved a smaller portion of their crop as commercials than usual. A June 28 frost last year seriously reduced the number of tubers above 6 ounces which are usually sold as table stock.

Cold weather has held back planting in south central and eastern Idaho. A few fields are planted around Jerome and Twin Falls. Most of the acreage will be planted by the latter part of May.

The intentions (1st of March) indicate 160,000 acres of potatoes in Idaho in 1950. The slow movement of certified seed would indicate that actual plantings will be below this figure. R. D. PELKEY.

INDIANA

Our potato growers have protested the Government's plan to further reduce the acreage by 26 per cent. We are in a deficiency area and last year the 20,000 acres planted was a new low since 1866. Unless our growers produce phenomenal yields, we will be a way out of line with other producing areas, especially in the Middlewest in supplying the consumer demand. E. L. Mitchell, Rochester, Indiana, legislative representative of the Northern Indiana Muck Crop Growers' Association and other growers, conferred with Senator Jenner of Indiana and Senator Brewster of Maine, being informed that no relief from acreage allotment is possible. At one time the people of this country were given the opportunity of working out their own plans and own salvation and did not try to change the principles evolved in the Ten Commandments. W. B. WARD.

FROM START TO FINISH...

insect and disease control can make or break your potato crop.

New insecticides solve the insect problem. And thousands of successful farmers are *growing and selling* bonus bushels every year by using DITHANE from start to finish to prevent blight losses.

IT PAYS TO USE

DITHANE

THE *TIME-PROVED* ORGANIC FUNGICIDE

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

DITHANE *is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.*

MAINE

Practically all Maine farmers are apparently planning to participate in the acreage allotment program which, of course, means price support. The 1950 program is essentially the same as 1949 with potatoes supported at 60 per cent of parity. Parity, however, has been refigured and the price will be slightly below the 1949 figure.

There are some individuals who are taking a stand against price support legislation following the 1950 crop. This attitude is gaining some momentum but until the provisions of new legislation are definitely known the extent of this feeling cannot be determined.

Government purchases to date have been 9631 cars of the 44,093 shipped. Last year corresponding figures were 36,026 cars purchased by the government of the 62,712 cars shipped. This indicates about 8000 cars more have been shipped to the trade than last year, ample proof that the Maine industry has done a real merchandising job. Imports of Canadian potatoes have resulted in loss of markets along the Eastern seaboard because of preferential boat rates.

The feeling in general is that the government has let the grower down, as many farmers have sold potatoes below support prices all the year in order to move their crop. The disposal program was put into operation late and many farmers resist a disposal program to the point that they will take less than support prices to assure that the potatoes go into consumptive channels.

Indications are that the season is about normal. Planting started on the 3rd of May and should be rather active by the 10th of May if this weather prevails.

The Florida readings on the Kennebec showed rather high spindle tuber counts. This has been something of a set-back to this variety but many workers feel that spindle tuber can be eliminated and that the Kennebec has desirable features which will result in its becoming one of the popular varieties.

VERNE C. BEVERLY.

NEBRASKA

Shipments of potatoes from western Nebraska points are drawing to a close at this time. Volume has been low during the month of April, and seed shipments stopped some time ago. Packing sheds have been operating part time only to clean up the few lots of table stock remaining in storage. A slight advance in the table market has been enjoyed by a small number of growers who held their potatoes for late sale.

A check of the records during the 1949-50 season shows a slight increase over last season in the volume of Certified seed shipments. As in previous years, however, quite a lot of Certified seed was diverted into table stock channels because the supply exceeded the demand from southern seed buying states. The Potato Development Division recently reported that a total of 8,961 cars of potatoes had been shipped from Nebraska this season up to the 1st of

FOR DEPENDABLE CONTROL OF ALL BLIGHT

Here's Why

1. **BETTER YIELDS**
   of more No. 1 potatoes
2. **SIMPLER—CHEAPER**
   No "specialized" products needed —easy to prepare
3. ***BETTER* CROP PROTECTION**
   Backed by 50 years experience

Potato growers use more Triangle Brand Copper Sulphate *than any other product* for dependable protection against *all* blight—early and late. And—besides protection at low cost, you actually get *higher yields* of No. 1 potatoes! Don't take chances . . . get practically guaranteed control — use Triangle Brand!

FREE! VALUABLE BOOKLETS

"More No. 1 Potatoes"
"Better Bordeaux Mixtures" "Zinc Sulphate"
"Basic Copper Sulphate"

PHELPS DODGE REFINING CORPORATION
Electrolytic Refiners of Copper
40 Wall Street, New York 5, N. Y.

April. Of this total, approximately 24 per cent were truck shipments.

Only a small percentage of Nebraska's 1949 potato crop was diverted to the Government price support program. Most growers had complied with acreage allotments, but many of them failed to complete eligibility requirements. As a consequence, the bulk of the crop moved through normal marketing channels, with most growers satisfied with the prices received.

Looking forward to the 1950 season, hearings to consider Marketing Agreements have been scheduled at Kearney, Nebraska for central Nebraska counties; and at Torrington, Wyoming for the western Nebraska and eastern Wyoming areas. Should either one or both show a favorable response at the hearings, a referendum will follow. WARREN TRANK.

NEW JERSEY

Most of the potato planting was finished before the 1st of May although a few growers did not finish until the 15th because of the cold wet weather. Many early planted potatoes are now up and stands are fair to good. Some seed piece decay has been reported but it is too early to determine the extent of this trouble.

The acreage planted is slightly less in 1950. It is hoped that no potatoes will have to be sold to the government this year and growers are anticipating that the regulations set up under the recently adopted marketing agreement will help produce orderly marketing. JOHN C. CAMPBELL.

NEW YORK

Spring late, hopes low, attitude poor! Growers are discouraged with low prices that adverse publicity potatoes have received and the false reports of potato growers gains. With 20 to 30 per cent cut in acreage they are mad and have a tough attitude toward any program or other government enterprise. They know there are too many potatoes but don't like to be told how many to raise when their cut is so much larger than the rest of the country, and they are nearest to market. Claims of inefficiency, bungling, incompetence, etc., are common.

The air will clear, a lot of potatoes will be planted although hopes are not yet high. As soon as the ground warms up, the usual urge to get to work on the next crop and forget the past will prevail.

On the 15th of May the Market Agreement hearing will be held. This will be preceded by a series of meetings in an effort to acquaint growers with the general idea of what it is all about. After the hearing and before the referendum, another series of meetings will be held in an effort to explain the thing so growers can vote intelligently.

All potatoes are pretty well cleaned up (May 1st), at least no more than normal remain. Prices have been slightly below support but a lot of spuds went to market. H. J. EVANS.

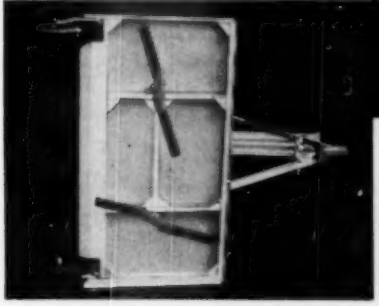
WOOD'S ROTARY CUTTER

All Purpose...All Weather Farm Cutter

Rugged...Heavy Duty
It Controls Corn Borers
IT CUTS and SHREDS

corn stalks
cotton stalks
potato vines
grain stubbles
green manure
weeds • thistles

Ask Your Dealer Today



YOU PLOW CLEAN and EASY AFTER CUTTING

A rugged, efficient, heavy duty cutter with oil sealed bearings and gear box, Wood's gives you years of trouble-free service. It conserves fertility of your soil, prevents erosion, adds humus, mulches topsoil, aids aeration.

Two 40" cutting blades, revolving at 1200 rpm on Timken bearings, make chaff of the material you cut. Strong all welded frame. Pneumatic tires.

WOOD BROS. MFG. CO.
OREGON • ILLINOIS

WOOD BROS. MFG. CO.
OREGON, ILLINOIS

Gentlemen:
I am interested in the WOOD'S ROTARY CUTTER. Send complete information and name of nearest dealer.

NAME.....

POSTOFFICE.....R.R.....

STATE.....

OREGON

A fine lot of certified Russet seed is available to Klamath Basin potato growers this year. Out of all the lots submitted by growers from Klamath county, Oregon, only two failed to meet foundation requirements, and these two lots were only slightly under foundation. The local disease control program has been a major factor in increasing the quality of certified seed.

Seed has not moved rapidly so far, and the additional reduction of approximately 10 per cent in the county's potato goal just recently announced, has left growers undecided. Nearly all acreage in the county will be under the program, and the marketing agreement undoubtedly, will be continued in effect.

Klamath Potato Growers' Association initiated a new way of marketing potatoes with a trial run of four cars marketed in the Bay Area of California. Potatoes were packed in special 10 pound dirt tight bags with handles and were properly labeled emphasizing quality. Eight of these bags were placed in cardboard containers with handles on each end, and were shipped direct to retail distributors. Potatoes were all of general use quality ranging from 4 to 10 ounces with no tolerance for defects. Fancy pack was not intended. Potatoes reached the consumer with very little damage. A card was placed in each bag asking consumer's comments. Of the replies received, 98 per cent were very favorable to this type of pack. The transporting cartons were sealed with heavy paper and the 10 pound bags were open at the top. While this was a trial on the part of the Klamath county growers, a lot of very fine information on marketing has been assembled, and will be used in improving the handling, marketing and consumption of potatoes. C. A. HENDERSON.

SOUTH CAROLINA

The local potato crop emerged to good stands almost on schedule but unseasonable frosts damaged much of it. The last and most severe of these frosts came on the 16th of April, a month later than normal. Early estimates were for a 25 per cent reduction in yield but drought followed this delayed recovery and it is apparent now that prospective yield has been cut by ⅓.

Aphids became a problem during the drought but now that good rains have fallen this pest is not considered serious. No late blight has been observed, although conditions have been favorable for its development during the past week. Extensive use of the Sebago variety and regular dusting with Copper or Dithane should prevent any serious damage this year.

The washers are being prepared for round the clock operation when digging gets under way the week of the 22nd of May. There will be a higher percentage of the crop washed this year than in any previous season. W. C. BARNES.

"biggest and best crop in years"

Increase your potato yield with protection measures against fungus disease the Mallinckrodt way. In ordering your Corrosive Sublimate (Bichloride of Mercury), Calomel, or Mercury Oxide Yellow Technical, be sure of highest quality by specifying MALLINCKRODT-MERCURIALS.

MALLINCKRODT CHEMICAL WORKS
80 Years of Service
to Chemical Users
Mallinckrodt St., St. Louis 7, Mo. • 72 Gold St., New York 8, N. Y.
CHICAGO • PHILADELPHIA • LOS ANGELES • MONTREAL
UNIFORM • DEPENDABLE • PURITY

Flexible Lockjoint

fmc

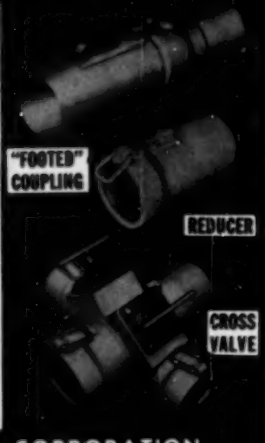
IRRIGATION SYSTEMS

RAIN WHEN YOU WANT IT

Check These Features

fmc malleable cast aluminum matched couplings with the **seven built-in features** plus the finest quality extruded thick wall, light weight aluminum pipe provides the most service benefits at lower cost.

Strong, stainless steel, non rusting Safety Link . . . Large heavy duty gasket retainer . . . Self Sealing heavy molded rubber replaceable gasket with feather edge for best fit . . . End of tubing flared inside coupling provides firm, lifetime anchorage . . . Tubing is permanently secured to coupling by exclusive fmc "staking" method . . . Couplings are machined to closely gauged tolerances and tubing pressed to fit, insuring positive water seal . . . Tubing is finest, heavy duty aluminum extension with uniformly thick wall.



FOOD MACHINERY AND CHEMICAL CORPORATION
FLORIDA DIVISION LAKELAND FLORIDA

For Further Details And Your Copy of The New Fmc Irrigation Catalog, write Drawer PJ-1.

SPRAYING or DUSTING
USE
"OHIO SUPERSPRAY" HYDRATED LIME

with a guaranteed fineness of 99½% passing a screen having 105625 openings per square inch. It contains magnesium and calcium. Insures greater coverage and yields.

OHIO HYDRATE & SUPPLY COMPANY
WOODVILLE, OHIO

Manufacturers of Various Forms of Lime and Limestone Products

MERCK PRODUCTS FOR THE GROWER

Corrosive Sublimate
Yellow Oxide Mercury

Hormodin (Available in powder or liquid form)

Hormodin is the root-forming chemical developed by The Boyce Thompson Institute for Plant Research, Inc.

Write for descriptive literature

MERCK & CO., Inc. RAHWAY, N. J.
Manufacturing Chemists
New York, N. Y. • Philadelphia, Pa. • St. Louis, Mo.
Elkton, Va. • Chicago, Ill. • Los Angeles, Calif.
In Canada: Merck & Co., Ltd.
Montreal Toronto Valleyfield

ES-MIN-EL

SOIL APPLICATION

Minerals are essential to the health of your plants and you can't grow crops rich in vitamins in soil deficient in the essential mineral elements. ES-MIN-EL contains the essential mineral elements of Magnesium, Copper, Iron, Boron, Zinc and Manganese. For farm crops, gardens, flowers and lawns — get ES-MIN-EL today! Follow directions!

ES-MIN-EL
ESsential MINeral ELements
TENNESSEE CORPORATION
SPRAY OR DUST

FREE BOOKLET

Send card for ES-MIN-EL booklet to: Tennessee Corporation, Grant Building, Atlanta, Georgia or Lockland, Ohio.

IF your soil was not properly mineralized before planting you can now get the new ES-MIN-EL for use in dusting or spraying—you can now feed your growing plants these essential mineral elements through the leaves and stems by applying an application of the new form of ES-MIN-EL used for spraying and dusting only. ES-MIN-EL spray or dust is a neutral form of Copper, Manganese and Zinc.

TENNESSEE CORPORATION

Atlanta, Georgia — Lockland, Ohio

POTASH and POTATOES

Potatoes are a major item in the American appetite. Potash is a major item in the potato appetite. Potatoes are greedy feeders on potash. They use more of this plant food than nitrogen and phosphoric acid combined. To grow a good crop of No. 1's, soil and fertilizer must supply at least 200 lbs. of available potash (actual K_2O) per acre. Consult your official agricultural adviser or experiment station about the fertility of your soil. Write us for information and literature on how to fertilize your crops.

American Potash Institute, Inc.

1155 SIXTEENTH ST., N. W. WASHINGTON 6, D. C.

Member Companies:

American Potash & Chemical Corporation
Potash Company of America United States Potash Company

Boggs

THE "STANDARD"
Potato and Onion Grader

Not only "STANDARD" but "SUPERIOR" in Economy, Accuracy, Speed, and Adaptability.

More Boggs Graders in use than all other makes combined—there must be a reason. Send for our new circular and price list.

BOGGS MFG. CORP., Atlanta, N. Y.

Why you buy EXTRA VALUE in *Niagara* DUSTS

1 **LABORATORY CONTROLLED QUALITY.** Every product is laboratory-tested before delivery.

2 **FIELD TESTED.** Niagara's research scientists approve for sale only those formulations of proved effectiveness.

3 **GROWER SATISFACTION.** An increasing number of growers buy their dusts from Niagara year after year... the best possible proof of customer satisfaction.

4 **FINEST DUSTING PROPERTIES.** Niagara dusts are free flowing and highly dustable.

5 **MANUFACTURING EXPERIENCE.** Niagara is a pioneer producer of crop-protecting chemicals... with more than 46 years of manufacturing experience.

6 **EXTRA SERVICES TO GROWERS.** Manufacturing and distributing facilities are located in the heart of major producing areas for quicker delivery service. A staff of trained and experienced insect-control and disease-control specialists service Niagara products. One of these Niagara specialists serves your community. Write to us and we'll have him contact you.

BUY NOW... FROM NIAGARA... AND BE SURE OF HEALTHY, INSECT-FREE CROPS (All of the following dust materials are available in various combinations.)

C-O-C-S fungicide • †Kolo sulphur • *Z-C fungicide
Niatox (DDT) • †PhosKil (parathion) • †GamKil (lindane)
BHC • †Hexamite (TEPP) • Calcium Arsenate • Rotenone

*Reg. U. S. Pat. Off. †Trademark

There is a Niagara crop duster for every grower, ranging in size from the Cyclo-Junior hand duster to a 24-nozzle power duster.

Niagara
CHEMICAL DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Middleport, New York

Richmond, Calif. • New Orleans, La. • Greenville, Miss. • Jacksonville, Fla • Tampa, Fla. • Pompano, Fla. • Burlington, N.
Canadian Associate: NIAGARA BRAND SPRAY CO., LTD, Burlington, Ontario

University Microfilms
313 North 1st St
Ann Arbor Michigan

Make Sure Your Potato Crop *Pays off!*

Growers report better protection with

IRON AGE POTATO SPRAYERS

GROWERS who count on potatoes for their big money crop know *it pays to spray the Iron Age Way*. Regular Iron Age Sprayers, like the power take-off unit shown here (equipped with special potato booms for spraying 3 to 16 rows, with 3 to 6 nozzles per row depending on row width) assure complete penetration, maximum coverage, lower spraying costs.

The famous Iron Age Pump maintains high pressures needed under all spraying conditions, and still takes a beating season after season without breakdowns. Here's what some Iron Age users say: "Sprayed over 155 acres the full season without putting a wrench to my pump" . . . "Get better coverage with Iron Age than any other sprayer I've ever seen."

PLANT AND SPRAY THE IRON AGE WAY

Whatever your acreage or your crop, it will pay you to find out how Iron Age spraying can give you greater coverage at lower cost. Sprayer models for every grower . . . 8 pump sizes, 6 to 50 gallon capacities. See your Iron Age Dealer, or write to:

A. B. FARQUHAR COMPANY
Farm Equipment Division
3401-Y Duke St., York, Pennsylvania

Farquhar
IRON AGE
YORK, PA.
POTATO AND VEGETABLE PLANTERS · TRANSPLANTERS
SPRAYERS · DUSTERS · POTATO DIGGERS · WEEDERS